"Your Money or Your Life!" The Influence of Injury and Fine Expectations on Helmet Adoption among Motorcyclists in Delhi

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Abstract

Road mortality is a growing burden in many developing countries, although many of these crashes are preventable. Behaviors adopted by road users while traveling is one key dimension on which governments usually play to reduce road accidents, either by stressing the potential injuries or by implementing fines if individuals do not adopt safe behaviors. This paper exploits original data collected among Delhi motorcyclists in 2011. I study the influence of perceived consequences of helmet non-use on the decision whether to wear or not such protective device. I also explore the role of previous experiences in the formation of these beliefs. I find that expected injuries are correlated with helmet use on long distance trips while expectations of financial sanctions are linked with helmet adoption on short distance journeys. Women react more than men to a given level of expected medical expenditures. Furthermore, poorer individuals are more likely to use a helmet for given levels of health costs and traffic fines. Simulations of policies influencing individuals' subjective expectations show that an intensification of police threat and information campaigns would increase helmet adoption among motorcyclists.

Key words: Subjective expectations, Road safety, Risky behaviors, India

JEL Classification: C81, D84, I15, K42, R41

1 Introduction

Every five minutes in India someone dies from a road traffic accident (NCRB, 2011). This phenomenon is expected to escalate to one death every three minutes by 2020. These striking figures highlight the growing burden road mortality represents in many developing countries. To counteract this trend, and given the high share of motorcyclists in the traffic mix, an increasing number of these countries have started to implement mandatory helmet regulations.[1] Despite such laws, and the fact that these fatalities are preventable and that wearing a helmet could prevent considerable health and financial costs for many households,[2] helmet use remains low in the majority of African and Asian countries. With a better understanding of road users' individual behavior, the effectiveness of such policies could be improved, yet this topic has been largely neglected in the economic literature.

To fill this gap, I study the determinants of helmet use in urban India. I exploit a unique dataset collected in 2011 among Delhi motorcyclists. I look at standard covariates such as sociodemographic characteristics and risk preferences. I pay special attention to beliefs regarding injuries and fines as individuals may differ in their expectations regarding the protection offered by a helmet, or the severity of police sanctions for its non-use. More precisely, road users are uncertain about the probability of being caught by the police for infringing road rules, or, in the event of an accident, of being injured and suffering financial, physical and psychological loss. Such subjective expectations are likely to influence the decision on whether or not to wear a helmet.

I first investigate the impact of subjective expectations of injury and fines on helmet adop-

[1] Indeed, Liu et al. (2008) highlighted that standardized quality helmets efficiently reduce the risk of mortality and injuries by 40% and 70% respectively.

[2] see Mohan (2001) for the case of India.

tion. I find that expected health consequences influence behaviors on long journeys, while anticipated police sanctions impact attitudes towards short distances. Moreover, I also find some differentiated effects. In particular, expected medical costs impact on women's decision to wear a helmet but not on men's. Furthermore, the influence of expected medical costs and expected financial penalties varies across income groups. This is consistent with the fact that health expenditure and traffic fines represent a smaller share of wealthier individuals' revenues. Overall, this shows that expectations of fines and injuries have a strong but differentiated impact on helmet adoption. In a second step, I explore the formation of motorcyclists' beliefs. I show that road exposure and previous experiences of road-related risks partly explain the elicited expectations.

Finally, I simulate the impact of different changes in individuals' subjective expectations on the percentage of helmet users among motorcyclists. Police threat through enforcement, information or fine levels should increase helmet use on short distance trips with a combination of these policies being the most effective. Information campaigns stressing the advantages of helmet use, in particular for short distance trips, are also likely to make motorcyclists adopt safer behavior.

This paper contributes to two different strands of literature. On the one hand it adds to the health-behavioral economic literature. As mentioned previously, very few studies have investigated the determinants of road safety behaviors. One exception is Ritter and Vance (2011) who looked at the socioeconomic characteristics influencing voluntary helmet use among German cyclists. The scarcity of behavioral analyses is mainly due to the absence of data on road habit issues. This paper provides, to my knowledge, the first empirical study on the determinants of helmet adoption in developing countries. This paper furthermore adds to the literature on subjective expectations of probabilities and outcomes. In recent years, individual decision-making has been the subject of studies in areas such as investment, education, health and entrepreneurship.[3] The paper builds on methodologies developed in this literature and provides a first application to driving behavior. The findings confirm, in the context under investigation, the key role played by subjective expectations in explaining actual behavior.

The remainder of the paper is organized as follows. In section 2 I discuss the channels linking previous experiences, subjective expectations and helmet use. I also present the identification strategies to be implemented in the empirical analysis. Section 3 introduces the data and the way subjective expectations have been measured. Section 4 reports the empirical findings. The impacts of different policy measures which either lead to increased expected medical costs or level of fines are reported in section 5. Section 6 concludes.

2 Mechanisms at play and identification strategy

Here I discuss the possible mechanisms at play and present the subsequent identification strategies which will be used in the empirical analysis.

I first investigate the role of subjective expectations on decision-making related to helmet use, along with additional variables which may directly impact the adoption of a head protection device. In a second step, I consider the formation and updating of individuals' beliefs regarding the medical expenditure and fines they expect to pay if they do not use a helmet. In particular, I look at whether personal experiences of road accidents or traffic police arrests influence motorcyclists' subjective expectations.

[3] See for instance, Attanasio (2009); Delavande and Kohler (2009); Dominitz and Manski (1997); McKenzie et al. (2007).

2.1 Influence of subjective expectations on helmet adoption

2.1.1 Subjective expectations

I examine here the impact of beliefs regarding injury and fines on helmet adoption.

Subjective expectations are composed of two components: (i) the likelihood that an accident or a police arrest will occur and (ii) the financial consequences of these events. When investigating motorcyclists' decisions, it may be more relevant to consider the product of these subjective components rather than the two dimensions separately. On the one hand, two motorcyclists who think they will be caught by the police if they do not wear a helmet but who have different expectations in terms of fines to be paid may not adopt the same conduct. On the other hand, a motorcyclist who thinks that he has a low probability of being injured but that, should he be involved in an accident, he will suffer severe injuries, and a person who believes he has a high probability of suffering an accident but that the subsequent medical expenditure will be rather small, may have the same attitude toward helmet use. It is therefore key to look at the combination of the two dimensions. I call this product of variables "unconditional expected costs" in the empirical analysis. This decision to consider the variables in combination is also motivated by the fact that no information regarding expected outcomes is available in the dataset for people who gave a zero probability of the negative event occurring. I set the unconditional expected costs to zero for those individuals.

2.1.2 Helmet use

In the following paragraph I highlight the heterogeneity of impacts that beliefs may have on helmet adoption depending on the circumstances of the journey.

Helmet use is a renewed decision, i.e. individuals decide whether or not to use a helmet before each of their motorbike trips. The characteristics of each journey (its length, the types of roads taken, etc.) are therefore likely to influence the use of head protection. Habits and routines may also to some extent be relevant to motorcyclists who may always use the helmet in some circumstances and never in others. Very short trips along quiet streets are commonly (but mistakenly) assumed to be less dangerous in terms of injuries. Although statistics from developed countries showed that a large share of accidents occur very close to the victims' home, road users often only consider the risk of injuries when taking long distance trips on major roads with a lot of vehicles circulating at a high speed. A reason for this may be the desire not to take into account all the risks in order to limit the stress generated by the fear of injuries. Indian motorcyclists may adopt similar reasoning. Furthermore, the probability of an accident occurring remains low for short distance trips when related to the number of times a person takes the same route. Given this difficulty in internalizing the ever-present health risks, it would not be surprising if subjective expectations of injuries either do not impact at all on safety behaviors or only influenced helmet use on long trips on main roads. Conversely, as traffic police operate throughout the city, both on main inner city roads and within neighborhoods, the threat of financial penalties is more likely to impact helmet use on short distance trips. In our survey, three different circumstances were presented to the respondents: trips (i) in residential neighborhoods (areas with small food and clothes markets), (ii) on main roads for short distances and (iii) on main roads for long distances (more than 15 minutes). While the first situation refers to narrow streets in residential or market areas, the two last cases correspond to journeys on large boulevards where the traffic is often heavy. The richness of the data collected will allow me to look at the impact of different types of subjective expectations on specific journey situations.

2.1.3 Sociodemographic characteristics

I discuss here additional variables which can impact on helmet use decision-making.

Preferences related to risk may impact on helmet usage through the adoption of safer conduct among risk-averse individuals (Grimm and Treibich, 2014). Age is also likely to affect the individual's time-related perspective of the amount of time he or she will have to lie with the consequences of a negative event. In relation to education level, this may capture the person's ability to collect and deal with information regarding road risks. Income earners, in particular heads of households, married people and individuals with children, may also opt for safer conduct because of their family responsibilities and the additional financial consequences implied by a temporary or permanent incapacity to work. Moreover, access to health care may also matter, through the mitigation of negative health consequences. Finally, people who believe that their life is in the hands of a superior force and that their date of death is already written may decide not to use a helmet despite high subjective expectations of injuries. All these variables are thus included in the specifications.

2.1.4 Identification strategy

I now turn to the identification strategy to be implemented in the empirical analysis to study the influence of subjective expectations on helmet adoption.

When studying the relationship between beliefs and behaviors, one may argue that local specificities may be correlated with an individual's subjective expectations and eventually bias the estimates. While some variables, such as the quality of roads, the incidence of road accidents or police presence, may impact on helmet use only through their effect on subjective expectations, other variables may have a direct effect on helmet use. For instance, the presence of private emergency services in the area is likely to be associated with the expected medical costs but may also partly influence the consequences of an accident, impacting directly helmet use. As for neighbors' attitudes, which reflect social norms, they are likely to be correlated with a motorcyclist's behavior regardless of his subjective expectations and may also modify the perceived consequences of helmet use. Therefore, living, for instance, in a neighborhood where no-one uses a helmet may simultaneously lower the level of helmet adoption by motorcyclists in the area and their subjective expectations of being caught by the police. This would lead to an underestimation of the true relationship between subjective expectations and helmet adoption. Conversely, the presence of private health centers may increase the medical expenditure individuals expect to incur in the event of a road injury but also decrease the level of helmet adoption as individuals may expect to receive particularly high quality care. This in turn would lead to an overestimation of the true coefficient. In other words, some unobservable characteristics at the geographical level are likely to be correlated with the independent regressors of interest and have a direct effect on the behaviors I attempt to explain. However, the direction of this bias is ambiguous.

In order to capture these potential local effects, I take advantage of the geographical division of New Delhi into 47 police zones or circles. Each zone has its own policing budget and man-power. 32 of these "circles" are represented in our survey.

I therefore estimate the following specification:

$$\text{Helmet use}_{it} = \beta_m \cdot \text{UEC}_i^{med} + \beta_f \cdot \text{UEC}_i^{fine} + \sum_j \gamma_j \cdot X_{ij} + \mu_c + \varepsilon_{ict} \quad (1)$$

Where i refers to the individual and t to the type of trip. Helmet use_{it} is a binary variable which equals one if the person wears a helmet and zero if not. UEC_i^{med} and UEC_i^{fine} are the unconditional expected medical costs and the unconditional expected fines respectively. X is a set of sociodemographic characteristics. Finally, μ_c corresponds to the respondent's circle of residence.

I run fixed effect linear probability estimations and obtain the effect of the variations in subjective expectations on helmet use within each police zone. I cluster all standard errors at that level to control for potential auto-correlation in the error terms. The variables of interest are the unconditional expected costs. I include several individual characteristics which are likely to be correlated with both subjective expectations (through the likelihood that the person has already experienced a road accident or a police arrest) and helmet adoption (through the expected costs and gains of helmet use); and which thus may bias the estimates. More precisely, I introduce gender, age, education level, marital status, number of children, monthly household income, personal contribution to the family revenues, religious beliefs, preferences toward risk and health insurance. Introducing police zone fixed effects in the estimations allows me to capture the previously mentioned specificities of each area along with the behaviors adopted by respondents' neighbors and the socioeconomic status of each residential locality. However, as Manski (1993) pointed out, these various effects are difficult to disentangle. Indeed, people with similar tastes and characteristics may select themselves into the same circles. Therefore, the absence of a significant impact of some of the explanatory variables might in fact be due to their rather limited variation within a circle. Yet, while circle effects pick up part of the differences in the level of actual risks faced by individuals in different neighborhoods, they do not annihilate them completely. This is because, for instance, of different traveling hours, different routes taken or the different driving skills of motorcyclists living in the same police zone.

2.2 Influence of previous experiences on subjective expectations

I now focus on the role of previous experiences on the formation of motorcyclists' beliefs.

2.2.1 The role of previous experiences

Below, I discuss the channels through which past experiences are likely to influence individual subjective expectations.

From every motorbike trip individuals obtain new information with respect to the health and financial risks they face from not using a helmet. This new information may, as defined by Haselhuhn et al. (2012), come from a traffic accident they witness (information via observation) or from being involved in a road crash themselves (information via personal experience). Motorcyclists are also likely to modify their beliefs after hearing the story of someone who has suffered from road injuries (information via description). Being involved in an accident and getting injured or being caught by the police while not wearing a helmet certainly increase the subjective expectations that such events occur. Nonetheless, the effect of personal experiences on expected medical costs and expected fines are more ambiguous. As a matter of fact, whether personal experience increases or decreases expected outcomes depends on (i) the individual's prior belief and (ii) the severity of the loss the person faces. In other words, if a person who expected to face tremendous medical expenditure in the event of a road accident is involved in a minor accident, he will certainly correct his expectations downwards. If, on the other hand, the motorcyclist thought that he would not sustain any injury, he will be more likely to modify his beliefs upwards. Furthermore, a person is prone to decrease or increase his perception of the expected fine to be paid in the event of being stopped by the police based on whether he was respectively able or not to corrupt the police officer. Finally, a same road experience may have different lasting effects depending on the frequency with which the victim uses the motorbike after the event. In the empirical analysis I look separately at subjective probabilities of injuries and fines and at the subsequent financial consequences. In order to study the potential differentiated effects mentioned above, I introduce in the specifications interaction terms between personal experiences and road habits or religious beliefs.

2.2.2 Other possible determinants

One may think of many other variables which may play a role in the formation of individuals' expectations.

Older people have had more time to experience road accidents or police arrest. Women, given their low participation in the labor market, have a much lower level of exposure to motorbike risks. Despite the influence of such sociodemographic characteristics, I focus, in the empirical analysis, on previous experiences. I only include the frequency and the purpose of motorbike use in the specifications to control, at least partly, for the probability that the motorcyclist experienced either a road accident or a police arrest. Religious practices are also introduced in the analysis as they may actually alter individuals' beliefs.

2.2.3 Identification strategy

Below I present the identification strategy to be implemented in the empirical analysis.

As previously mentioned, road hazards and police enforcement intensity are likely to vary across neighborhoods and influence subjective expectations. If in a given area police officers are more present, individuals living in that neighborhood are likely to report higher levels of subjective probabilities of being stopped by the police. Similarly, in an accident-prone area, individuals are more likely to report higher levels of subjective probabilities of being involved in an accident. These characteristics may thus bias the estimates if not tackled adequately.

Given these local effects, I again take advantage of the administrative organization of Delhi and estimate the following specification:

$$\text{Expectation}_{itk} = \beta \cdot \text{Experience}_{it} + \sum_j \gamma_j \cdot X_{ij} + \mu_c + \varepsilon_{itck} \tag{2}$$

I consider separately three different outcomes, refered to as "Expectation" in the above equation: the subjective probabilities, the expected costs and the variance regarding these costs which is captured by the inter-quartile range. k thus takes three different values and refers to these three different types of expectations. The variables of interest are previous experiences, labeled "Experience" and differ depending on the type of subjective expectations, t, considered (injury or fine). Both personal and relatives' experiences of road accidents are introduced as dummy variables in the analysis when considering expected injuries. The perceived discretionary power of the police and one's bargaining power are included when studying expected fines. X is composed of religious and motorbike use variables. The latter are introduced to capture possible differences in road risks and traveling experiences. Finally, μ_c corresponds to the respondent's circle of residence.

It is important to note that the cross-section data at hand allows me only to identify whether individuals who have experienced a traffic accident or who have been sanctioned by the traffic police report significantly different beliefs regarding injuries and fines.

3 Data

In this section, I introduce the data and the survey methods to measure subjective expectations. Some descriptive statistics are also displayed.

3.1 Road safety survey

My colleagues and I implemented an household survey in Delhi in 2011 targeting motorcyclists. Up to three drivers or passengers per household were allowed to answer the survey. In the end, 902 motorbike users were interviewed. A part from sociodemographic characteristics, we also gathered data on risk aversion, perceptions of road rule enforcement and road risks, along with helmet use, and previous involvement in road traffic accidents or traffic police arrests. Finally, we attempted to elicit the subjective expectations of medical expenditure and fines, based on the methodologies developed in the literature and described in more detail below.

3.2 General characteristics

The motorcyclists interviewed in this survey have the following socioeconomic characteristics.

Our respondents are on average 36 years old, two thirds of them are men and 70% pray daily. Men represent 97% of the drivers and only represent 25% of the passengers. Regarding road safety efforts, while men use full face helmets, women more often opt for a half helmet. Motorcyclists were asked about their helmet use in three different circumstances. On average, motorbike users are more likely to declare wearing a helmet for long trips (81%) than for short trips on main roads (61%) or trips in residential neighborhoods (54%). Furthermore, significant differences in helmet use are observed between men and women, drivers and passengers, and frequent and occasional users of this mode of transportation. Drivers without passengers travel at a higher speed on average. More than 60% of the passengers declare that they traveled with three or more people on the same motorbike. 46% of the respondents declare frequently traveling on a motorbike, 64% use it mainly to commute to work. Finally, 7% of the interviewed motorcyclists had already been involved in a road accident, about the same percentage that had been sanctioned by the traffic police for not wearing a helmet.

3.3 Subjective expectations of medical expenditure and fines

In the section below I explain in detail the assessment of subjective expectations.

3.3.1 Probability of injury and subsequent medical expenditure

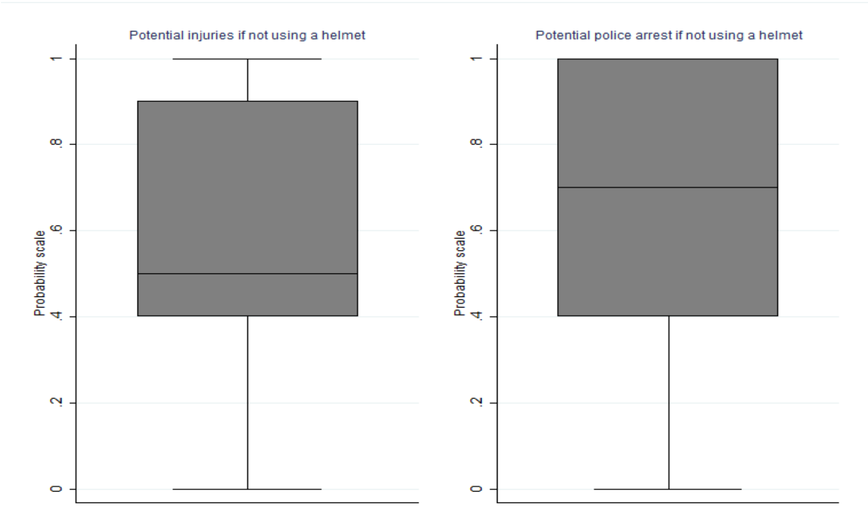
Starting with potential injuries, two situations were presented to the interviewees.

First, they were asked to think of how they usually travel on their motorbike ("in general"). Second, they were asked to think of a situation in which they would not use the helmet ("if no helmet"). In each case, respondents were asked to establish the likelihood that they would be involved in an accident and injured using an 11 point response scale ranging from 0 "this event will never happen" to 10 "this event will surely happen". Answers were divided by ten in order to obtain values between 0 and 1 which can be related to probabilities.

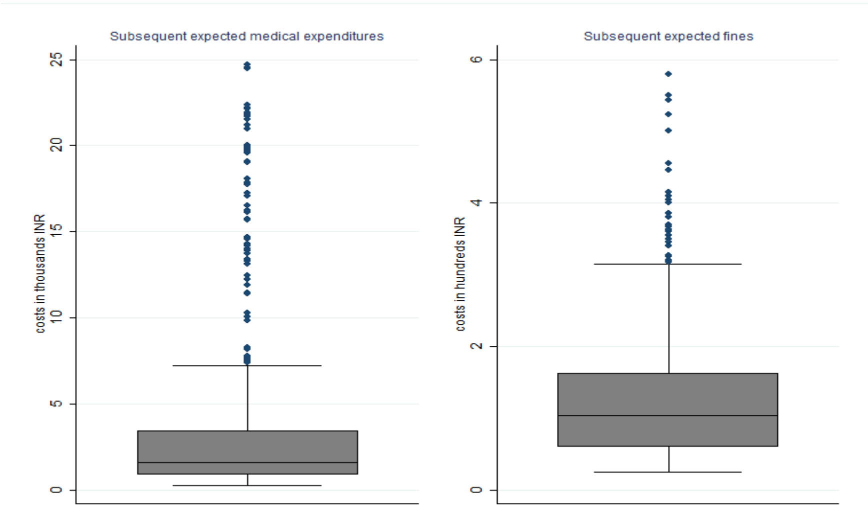
Table 1 provides the distribution of subjective probabilities of injury in the two situations of interest. Notably, the "if no helmet" variable is on average higher and has fatter tails than the "in general" probability. Graph 1a illustrates the distribution of subjective probability of being hurt if not wearing a helmet. This subjective probability varies substantially among respondents; even for individuals of similar gender, education, and religion or those presenting the same level of risk aversion (results not shown in Figure 1a).

Table 1: Distribution of subjective probabilities of injuries and police arrest

	percentile					
	25^{th}	50^{th}	75^{th}	mean	std. dev.	*observations*
Probability of injury						
in general	0.2	0.4	0.5	0.37	0.25	*841*
if no helmet	0.4	0.5	0.9	0.58	0.31	*836*
Probability of arrest						
in general	0.2	0.4	0.5	0.39	0.29	*840*
if no helmet	0.4	0.7	1	0.65	0.34	*878*
for no reason	0.1	0.3	0.5	0.36	0.30	*845*



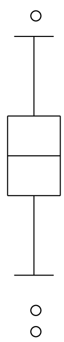
a. Subjective probabilities if non use of helmet



b. Subsequent expected outcomes

Figure 1: Heterogeneity in beliefs

Box plot legend:



upper adjacent value

75$^{\text{th}}$ percentile
median
25$^{\text{th}}$ percentile

lower adjacent value
outside values

If the individual answered that the probability of being hurt while not using a helmet was greater than zero, the interviewer proceeded with questions regarding the subsequent medical expenditure. More precisely, respondents were asked what was the percent chance that the medical expenditure would be less than a series of fixed amounts increasing from 500 INR up to 200,000 INR. The enumerator kept proposing higher amounts till the respondent answered 100% (see Attanasio, 2009; Delavande et al., 2011, for reviews of this method).

Based on the elicited cumulative distribution function, the expected costs for each respondent were built using the following methodology. p_{ik} denotes the percent chance that the cost will be less than the amount C_k for individual i. The motorcyclist's expected cost $E_i(C)$ is then equal to :

$$E_i(C) = \sum_{k=1}^{n} (p_{ik} - p_{ik-1}) \cdot \left(\frac{C_k + C_{k-1}}{2} \right)$$

with $\frac{C_k + C_{k-1}}{2}$ the central value of each interval and $p_{ik} - p_{ik-1}$ the percent chance associated with each interval. Initial values C_0 and p_{i0} are equal to zero.[4]

The average expected medical cost is 5,189 INR (94 EUR in 2011).[5] We observe a lot of heterogeneity across motorcyclists, the standard deviation being equal to 9,012 INR (see Table 2). Based on provided answers, the 25$^{\text{th}}$ and the 75$^{\text{th}}$ percentiles were derived through linear extrapolation. When a respondent gave a higher percentage than 25% or 75% for the first proposed amount, the lowest level of medical expenditure (500 INR) was imputed to the related

[4]When using different computations of the first central value (either by applying an exponential function or a power function instead of a linear one or fixing a strictly positive minimum amount of medical costs), the expected cost is barely modified – between 0.27% and 1.36% of change.

[5]I cannot compare this figure with actual medical expenses faced by road victims due to unavailability of hospital data.

percentile.[6] Inter-quartile range (75$^{\text{th}}$ percentile - 25$^{\text{th}}$ percentile) captures the variation in the potential financial costs individuals have in mind. The extent of potential medical expenditure appears to vary a lot across respondents. Some individuals may consider both minor and extremely severe injuries when answering the outcome question, while others may have a clear opinion of what type of injuries they would face. We note that expectation and variance parameters of medical expenditure are significantly correlated with the type of injuries a person thinks he would suffer from if he was not wearing a helmet at the time of the crash. More precisely, they are positively related to head trauma and negatively correlated with injuries to limbs.

Table 2: Summary statistics of expected medical expenditure and fines

	observations	mean	std. dev.	median	minimum	maximum
Expected costs (in INR)						
medical expenditure	*772*	5,189	9,012	1,688	250	64,003
fines	*760*	129	103	105	25	783
Inter-quartile range (in INR)						
medical expenditure	*772*	6,718	15,039	1,500	0	94,000
fines	*760*	112	109	88	0	500

3.3.2 Probability of police arrest and subsequent fines

I now turn to the elicitation of subjective expectations regarding traffic offenses.

The mandatory helmet law aims at providing incentives for helmet use through financial penalties. Such sanctions are likely to modify motorcyclists' behavior only if they are credible and sizable enough. To capture the actual beliefs of motorcyclists regarding helmet legislation, respondents were asked about their subjective probabilities of being stopped by the police in the next month in three different situations. In addition to the "in general" and "if no helmet" cases, individuals were asked about the likelihood that they would be stopped by the police for

[6] The minimum of 500 INR has been imputed to the 25$^{\text{th}}$ percentile for 236 individuals and to the 75$^{\text{th}}$ percentile for 97 of them.

no reason (situation labeled "for no reason" in the following sections). It seemed important to set this third case given that unfair and random police sanctions may have an unproductive and potentially adverse effect on safety decisions. From Table 1, it appears that the mean of the perceived probability of being stopped by the police in the "if no helmet" situation is much higher than "in general" or "for no reason" (0.65 vs. 0.36-0.39). The variance is also slightly higher.

As with the expected medical expenditure in the event of injury, when the respondent said that there was a positive probability of being stopped by the police when not wearing a helmet, his expectations regarding the fine he would have to pay were elicited by the interviewer. More precisely, interviewees were asked what was the percent chance the financial penalties would be less than a series of fixed amounts increasing from 50 INR up to 1,000 INR: the official fine for infringing the helmet law was 100 INR at the time of the survey. Following the same methodology as used to derive the expected medical expenditure, expected fines were computed for each individual. The individual's lack of information regarding the level of financial penalties was also derived by computing the inter-quartile range.[7] On average, motorcyclists slightly overestimate the financial sanctions with the observed mean of expected fines across respondents in the sample being 129 INR (see Table 2).

Nonetheless, the variation in answers is quite important and half of the respondents have expectations which do not exceed the official fine. The dispersion parameter also indicates that the level of the official fine is rather unclear for many individuals given that on average interviewees gave an inter-quartile range which was higher than the official fine (112 INR).

[7] In this case, the minimum of 50 INR was imputed to the 25th percentile for 330 individuals and to the 75th percentile for 78 of them.

4 Results

In this section, I first present the results related to the influence of subjective expectations on the decision of whether or not to wear a helmet. In a second step, I report the findings regarding the impact of previous experiences on individuals' beliefs.

4.1 Influence of subjective expectations on helmet adoption

In order to investigate the influence of injury and fine expectations on helmet adoption, I will first study the impact of unconditional expected costs and report the effect of the other sociodemographic characteristics. I will then decompose the unconditional expected costs in order to see whether one of the components plays a greater role in the decision to use a helmet. Finally, before turning to the role of previous experiences in the formation of subjective expectations, I will examine the direct effect of these past events on helmet use.

4.1.1 Studying the impact of unconditional expected costs

In this part I look at the influence of unconditional expected costs regarding injuries and fines on motorcyclists' decision to use a helmet (cf. equation 1).

Table 3 presents the results obtained from the fixed effect linear probability specifications for the three types of trips considered.[8] Police threat and fear of injuries appear to impact on helmet use in different ways depending on the journey context. Indeed, it seems that subjective expectations with respect to fines increases helmet use on short distance trips. Conversely, higher expected medical expenditure leads to greater helmet adoption on long distance trips only. More precisely, a raise of 1,000 INR in the unconditional expected medical costs increases by 0.5 percentage points the probability that the person will wear a helmet on long trips on

[8]From the Hausman test results, it seems that the fixed effect specification should always be preferred to the ordinary least square estimation. When looking at helmet use on short distance trips on main roads, the random effect specification appears to provide more efficient estimates. As these results are very similar to the fixed effect ones, I decided to present only the fixed effect coefficients to avoid any confusion when reading the Table.

main roads. An increase of 100 INR in the unconditional expected fines increases by respectively 7.7 and 4.9 percentage points the probability of using a helmet for short trips on main roads and trips in residential neighborhoods. One issue with linear probability estimations is that predicted value may be out of the probability range. This is actually the case for only 40 (6%), 13 (2%) and 11 (1.7%) observations regarding respectively helmet use on long distance trips on main roads, short distance trips and trips in residential areas.

Table 3: Influence of expectations on helmet use - using unconditional expected costs (UEC)

Helmet use	**on main roads**		**trips in the**
	long trips	**short trips**	**neighborhood**
	(1)	(2)	(3)
UEC medical expenditure (th. INR)	0.005^{+}	-0.000	0.001
	(0.003)	(0.004)	(0.004)
UEC fines (hund. INR)	0.011	0.077^{***}	0.049^{**}
	(0.018)	(0.018)	(0.023)
R^2	0.296	0.261	0.243
Observations	*670*	*673*	*665*
Hausman test (p-value)			
OLS vs. FE	0.000	0.000	0.000
FE vs. RE	0.000	1.000	0.000
Predicted values			
1^{st} percentile	0.248	0.047	-0.002
99^{th} percentile	1.071	1.024	0.094

Notes: *** 1%, ** 5%, * 10% and + 15% significance.
Fixed effect linear probability estimations with clustered standard errors reported in parentheses. UEC medical expenditure is the product of the probability of being injured if no helmet and the subsequent medical costs. UEC fines is the product of the probability of being caught by the police if no helmet and the subsequent fine. Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income, Sikh, caste, risk aversion, health insurance and a belief in the existence of a superior force.

4.1.2 Looking at the effect of sociodemographic characteristics

Alongside the impact of the main variables of interest presented in the previous subsection, some sociodemographic characteristics are also related to the adoption of a head device. I report below the main findings (results not reported in Table 3).

Men are significantly more likely to use a helmet than women, while Sikhs are significantly less likely than motorcyclists belonging to other religious communities to use such a protective device. More precisely, when considering long distance trips, the probability of using a helmet increases by 41 percentage points if the motorcyclist is a man and decreases by 27 percentage points if he or she is a Sikh. These findings are consistent with the fact that Sikhs successfully lobbied against the use of helmets on the grounds that it goes against their religious beliefs. They managed to persuade the Delhi government to exempt them from the obligation to wear a helmet. De facto, the helmet law has not been enforced on women due to the difficulty of distinguishing a Sikh from a Hindu or a Muslim.[9] Having health insurance has a significant and negative impact on helmet use only for long distance trips when not controlling for the circle of residence. The absence of an effect of access to health care on helmet use may actually be explained by the inefficiency of ambulance services. According to Hsiao et al. (2013), 58% of all road traffic injury deaths in India occur at the scene of the collision, either immediately or while waiting for the emergency ambulance to arrive. No effect of income or level of education are detected. Finally, preferences toward risk do not appear to significantly influence motorcyclists' behavior.

Some individual sociodemographic characteristics are likely to modify the influence of subjective expectations on helmet adoption. In particular, women may be more sensitive to health issues and react more strongly to a given level of expected medical costs. When absolute amounts of medical expenditure and fines have been elicited, poorer individuals may be more responsive to a given level of costs as these represent a bigger share of their income. Finally, more risk-averse individuals may adopt safer behaviors than less risk-averse motorcyclists to

[9] This softness in the implementation of mandatory helmet law came to an end in September 2014. Traffic police began to prosecute women riding two-wheelers without a helmet, Sikh women being exempted only if they were able to prove their identity (source: The Times of India, September 11, 2014).

avoid the same amount of costs. In order to study such differentiated effects, I interact the unconditional expected costs with gender, level of income and preferences toward risk. Results are reported in Table 4. Interestingly, when including these interaction terms, I find that the probability of wearing a helmet on long distance trips increases by 2.3 percentage points if the level of unconditional expected medical costs raises by 1,000 INR. The net effect of injury expectations almost vanishes among men. Similarly, for the same level of subjective medical costs women are more likely to use a helmet on short trips on main roads. An income gradient is found when introducing interaction terms between subjective expectations and levels of income. More precisely, poor and middle income individuals are less likely to wear a helmet than individuals belonging to a wealthier household. Moreover, an increase of 1,000 INR in the unconditional expected medical costs increases the probability of wearing a helmet for short distance trips on main roads by 1.6 percentage points more among the poorest individuals (31% of the sample) compared to individuals who belong to the wealthiest families (17% of the sample). Similarly, a given level of unconditional expected fines induces a significant difference in the use of head protection between middle income individuals and wealthier individuals. Finally, the impact of unconditional expected fines on helmet use for short trips on main roads decreases with the motorcyclists' level of risk aversion. While one might expect risk preferences and beliefs to reinforce one another, this finding may be explained by the fact that preferences toward risk already partly influence the behavior of more risk-averse motorcyclists, or by the fact that extremely risk-averse individuals with high expected medical costs simply do not use this mode of transport and are de facto excluded from our survey.

Table 4: Differentiated influence of expectations on helmet use by gender, income, risk aversion

Helmet use	**on main roads**				**trips in the neighborhood**	
	long trips		**short trips**			
	(1)	(2)	(3)	(4)	(5)	(6)
UEC medical expenditure (th. INR)	0.005^{+}	$0.023^{\star}$	-0.000	0.002	0.001	0.014
	(0.003)	(0.013)	(0.004)	(0.012)	(0.004)	(0.015)
UEC fines (hund. INR)	0.011	-0.005	$0.077^{\star\star\star}$	$0.180^{\star\star\star}$	$0.049^{\star\star}$	0.003
	(0.018)	(0.074)	(0.018)	(0.062)	(0.023)	(0.066)
Male	$0.409^{\star\star\star}$	$0.430^{\star\star\star}$	$0.414^{\star\star\star}$	$0.480^{\star\star\star}$	$0.390^{\star\star\star}$	$0.393^{\star\star\star}$
	(0.052)	(0.059)	(0.061)	(0.059)	(0.070)	(0.062)
Male × UEC medical expenditure		$-0.019^{\star}$		$-0.019^{\star\star}$		-0.014
		(0.009)		(0.009)		(0.011)
Male × UEC fine		0.024		-0.008		0.030
		(0.046)		(0.039)		(0.033)
Household monthly income, *ref: Rich (above 20,000 INR)*						
Poor (less than 10,000 INR)	-0.013	-0.066	-0.095^{+}	$-0.180^{\star\star}$	-0.092	$-0.165^{\star}$
	(0.042)	(0.062)	(0.064)	(0.071)	(0.078)	(0.091)
Middle (between 10,000 and 20,000 INR)	-0.019	-0.044	$-0.097^{\star\star}$	$-0.090^{\star}$	-0.062	$-0.162^{\star\star\star}$
	(0.038)	(0.046)	(0.040)	(0.053)	(0.049)	(0.057)
Poor × UEC medical expenditure		0.001		$0.016^{\star\star}$		0.012
		(0.007)		(0.008)		(0.012)
Middle × UEC medical expenditure		0.002		0.002		0.012
		(0.007)		(0.007)		(0.009)
Poor × UEC fines		0.044		0.038		0.043
		(0.031)		(0.029)		(0.043)
Middle × UEC fines		0.016		-0.008		$0.076^{\star\star\star}$
		(0.032)		(0.030)		(0.026)
Risk aversion (average, 8 points)	-0.009	-0.009	0.002	0.020	0.001	0.005
	(0.015)	(0.022)	(0.013)	(0.019)	(0.014)	(0.018)
Risk aversion × UEC medical expenditure		-0.000		0.001		-0.002
		(0.001)		(0.002)		(0.003)
Risk aversion × UEC fine		-0.003		$-0.021^{\star\star}$		-0.003
		(0.012)		(0.010)		(0.012)
R^2	0.296	0.317	0.261	0.287	0.243	0.255
Observations	*670*	*670*	*673*	*673*	*665*	*665*

Notes: *** 1%, ** 5%, * 10% and $^{+}$ 15% significance.

Fixed effect linear probability estimations with clustered standard errors reported in parentheses.

Controls are marital status, # of children, head of household, age, education level, contribution to income, Sikh, caste, health insurance and a belief in the existence of a superior force.

4.1.3 Decomposing the unconditional expected costs

Below I consider the effect of subjective probabilities and the consequences on helmet adoption separately.

In the previous analysis, the variables of interest were the products of the subjective probabilities of being hurt or being stopped by the police when not using a helmet and their respective subsequent expected costs. This choice was partly driven by the fact that individuals who think that injury or police arrest will never occur were not questioned about the possible financial consequences of these events. This effectively excluded 104 individuals from the sample. Nonetheless, for the sub-sample of respondents who provided a positive probability of injury and fine, I am able to investigate the respective roles of subjective probabilities and subsequent outcomes on helmet adoption. Furthermore, one may argue that the variety of potential financial consequences is also a dimension which motivates the conduct adopted by motorcyclists. Therefore, I also include the inter-quartile range in the specification in order to study the influence of variance and lack of information regarding possible losses on an individual's risky behaviors.

Table 5 presents these findings. When comparing the coefficients of unconditional expected costs obtained with the full sample (Table 3) and with the restricted one (see Table 5 – columns 1, 4 and 7), we see that stronger effects are obtained with the latter sample both in terms of significance of the coefficient (for long distance trips) and in terms of its magnitude (for short distance trips). When looking at the respective effect of "frequency" (subjective probabilities) and "severity" (expected costs) dimensions (columns 2, 5 and 8), we note that expected costs actually drive the relationships previously detected between subjective expectations of injury and fines and helmet use on different types of trips. Finally, when introducing the dispersion dimension in the regression (columns 3, 6 and 9), I find that an increase of 1,000 INR in the expected medical expenditure increases by 1.5 percentage points the probability of wearing a helmet on long distance journeys. Conversely, a similar increase in the variance regarding such costs decreases by 0.7 percentage points the probability that the motorcyclist will adopt a safe behavior. A similar relationship between subjective medical costs and helmet use are found with short distance trips on main roads. Regarding expected fines, for both short distance trips on main roads and trips in residential neighborhoods, the lack of information regarding the level of fine drives the individual's behavior. More precisely, an increase in 100 INR of the dispersion in the fine boosts the probability of using a helmet by around 6 percentage points. The coefficient of expected financial cost is no longer significant.

Table 5: Influence of expectations on helmet use - non zero probability sample

Helmet use	**on main roads**						**trips in the neighborhood**		
	long trips			**short trips**					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UEC medical expenditure (th. INR)	0.005*			0.000			0.002		
	(0.003)			(0.003)			(0.004)		
UEC fines (hund. INR)	0.001			0.085***			0.059**		
	(0.021)			(0.016)			(0.026)		
Subjective probability of injury		0.077	0.085		-0.164	-0.158		0.064	0.051
		(0.062)	(0.065)		(0.142)	(0.141)		(0.120)	(0.116)
Expected medical costs (th. INR)		0.003*	0.015**		0.002	0.017**		-0.000	-0.012
		(0.002)	(0.007)		(0.003)	(0.007)		(0.003)	(0.008)
IQR of medical costs (th. INR)			-0.007*			-0.008**			0.007
			(0.004)			(0.004)			(0.004)
Subjective probability of arrest		-0.001	-0.003		0.163	0.163		-0.004	-0.003
		(0.052)	(0.050)		(0.103)	(0.102)		(0.071)	(0.073)
Expected fine (hund. INR)		-0.013	-0.020		0.065***	0.013		0.075***	0.028
		(0.023)	(0.033)		(0.014)	(0.030)		(0.022)	(0.034)
IQR of fine (hund. INR)			0.008			0.061**			0.056**
			(0.026)			(0.026)			(0.024)
R^2	0.262	0.264	0.269	0.244	0.253	0.265	0.223	0.231	0.239
Observations	*589*	*589*	*589*	*591*	*591*	*591*	*583*	*583*	*583*

Notes: *** 1%, ** 5% and * 10% significance. Fixed effect linear probability estimations with clustered standard errors reported.
Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income caste, risk aversion, health insurance and a belief in the existence of a superior force.
IQR stands for inter-quartile range and captures the dispersion in the outcome.

4.1.4 On the direct influence of experiences on helmet use

While previously implicitly assuming that past experiences of road accidents or police sanctions only influence helmet use through expectations, in the next paragraph I investigate the direct influence of previous road related events on helmet adoption.

Indeed, these types of events per se are likely to impact the safety conduct adopted by motorcyclists. Haselhuhn et al. (2012) used data on video rental fines and showed that, controlling for the level of information regarding the financial sanctions resulting from a delay in returning the video, previous experience with a fine significantly improved the future compliance rate. Using the same specification as the one presented in Table 3, I introduce road accident and police arrest as explanatory variables along with interaction terms between (i) road accident and unconditional expected medical costs and (ii) police arrest and unconditional expected fines. From Table 6, we note that the effect of injury expectations on helmet use for short trips is lower among individuals who have been involved in a traffic accident. The effect of fine expectations on helmet use for trips in residential neighborhoods among individuals who have been caught by the traffic police doubles compared to its effect among those who have never been in that situation. This last result shows the importance of combining information and enforcement to make motorcyclists adopt safe behaviors.

Table 6: Differentiated influence of expectations on helmet use by previous experiences

Helmet use	**on main roads**				**trips in the neighborhood**	
	long trips		**short trips**			
	(1)	(2)	(3)	(4)	(5)	(6)
UEC medical expenditure (th. INR)	0.005	0.005	-0.000	0.000	0.001	0.002
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)
UEC fines (hund. INR)	0.010	0.007	0.077***	0.085***	0.049**	0.031
	(0.018)	(0.023)	(0.018)	(0.021)	(0.023)	(0.026)
Road accident		-0.049		-0.015		-0.097
		(0.059)		(0.061)		(0.064)
Road accident × UEC medical expenditure		-0.002		-0.010**		0.002
		(0.005)		(0.004)		(0.005)
Police arrest		0.030		0.047		-0.112
		(0.050)		(0.072)		(0.095)
Police arrest × UEC fines		0.009		-0.041		0.080**
		(0.026)		(0.031)		(0.030)
R^2	0.287	0.289	0.259	0.262	0.242	0.248
Observations	*662*	*662*	*665*	*665*	*657*	*657*

Notes: *** 1%, ** 5% and * 10% significance.
Fixed effect linear probability estimations with clustered standard errors reported.
'Road accident' and 'Police arrest' are binary variables taking value one if the person has such experience.
Controls are gender, marital status, # of children, head of household, age, education level, income,
contribution to income, Sikh, caste, risk aversion, health insurance and a belief in the existence of a superior force.

4.1.5 Robustness checks

In order to provide evidence for the reliability of these findings, I implement different robustness checks, the results of which are reported below. More precisely, I replace the expected level of medical costs and fines by maximum values, I investigate a possible reverse causality effect, I introduce additional potential omitted variables and finally, I control for the understanding of the probability scale used to assess the expected probabilities.

First, one may argue that it is the highest possible values with respect to potential financial consequences (i.e. the costs corresponding to the worst case scenario the individual has in mind), rather than its expected level, which motivates the conduct adopted by motorcyclists. When replacing expected costs by the 75^{th} percentile or the maximum value, I find similar results regarding the influence of subjective expectations on helmet use (Table not shown).

Another important concern regarding the previous results is the possibility that individuals who decide not to wear a helmet may report lower expectations of negative consequences in order to reduce the stress induced by the behaviors they choose to adopt. This effect is known as cognitive dissonance and was first highlighted by Akerlof and Dickens (1982). In order to tackle this reverse causality issue, I show that helmet use does not cause subjective expectations regarding injury or fine. To do so, I take advantage of a regulation implemented in Delhi in July 2009 that makes it compulsory to provide a helmet with every new motorbike that is sold. I regress unconditional expected costs on helmet use, instrumenting the latter variable by mandatory helmet provision. More precisely, the instrument takes value one if the respondent is a driver and rides a motorbike purchased first hand less than two years ago. This variable can be convincingly assumed to be exogenous and unrelated with any omitted variable. Results presented in Table 7 show that the instrumental variable (helmet provision) is positively and significantly correlated with the endogenous regressor (helmet use) and that helmet adoption does not explain fine or injury expectations. Such results confirm the direction of the relationship between subjective expectations and helmet use and therefore also the results previously found.

Table 7: Reverse causality tests

	UEC med. (1)	UEC fine (2)	UEC med. (3)	UEC fine (4)	UEC med. (5)	UEC fine (6)
Helmet use						
Long trips on main roads	1.860	1.188				
	(9.388)	(1.796)				
Short trips on main roads			0.709	0.404		
			(3.213)	(0.595)		
Trips in the neighborhood					2.335	0.905
					(6.993)	(1.298)
observations	*670*	*670*	*673*	*673*	*665*	*665*

	on main roads: for long trips	on main roads: for short trips	for trips in neighborhoods
First stage			
Helmet provision (=1) †	0.062***	0.182***	0.092*
	(0.021)	(0.044)	(0.054)
Weak identification test ‡	8.901	16.900	2.873
F statistic	12.08***	15.85***	17.95***
R^2	0.281	0.236	0.252
observations	*670*	*673*	*665*

Notes: *** 1%, ** 5% and * 10% significance. Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income caste, risk aversion, health insurance and a belief in the existence of a superior force. † helmet provision is a dummy variable which takes value 1 if the respondent is a driver and rides a motorbike purchased first hand less than 2 years ago and 0 otherwise. ‡ Kleibergen-Paap rk Wald F statistic.

Furthermore, I acknowledge that some individual's personality characteristics (such as optimism, overconfidence regarding one's driving skills, time preferences, level of speed or road habits) still remain unobserved and might bias the results previously obtained. Optimism, for instance, is likely to reduce the subjective probability of an accident and the expected injury's seriousness. Similarly, overconfident drivers are likely to think they are able to avoid both police officers and road accidents. These two characteristics, so far unobserved, are negatively correlated with the perceived usefulness of a helmet. As for the velocity at which motorcyclists drive, it certainly increases the probability of an accident and the severity of injuries. If low speed and helmet use are substitutes for each other (Grimm and Treibich, 2014), individuals with high subjective expectations of injuries may decide to reduce their speed instead of wearing a helmet. The estimates would in that case be an overestimation of the true relationship between beliefs and head protection use. As for the absence, in the formulation of the question, of a clear time horizon to be considered by the respondent when answering a question on the likelihood of being hurt in a road accident, I acknowledge that comparability between individuals may be problematic. Some individuals may refer to the next trip while others think about their entire lifetime. Nevertheless, the absence of a time horizon would jeopardize the findings presented only if individuals who refer to a really short time horizon are different from those who consider their whole life. One may argue that individuals more oriented to the present may be more likely to refer to the next motorbike trip and then may report lower probabilities of injuries. If preference for the present is negatively correlated with subjective expectations (and not included in the analysis) then the estimate of unconditional expected medical costs on helmet use will be an underestimation of the true relationship.

When including average speed, road habits, a preference for living in the present and confidence in one's driving skills to the specifications, the previous results remain similar (Table not shown). A significant relationship between subjective expected medical costs and helmet use on long distance trips appears when average speed is added to the specification. Moreover, we note that subjective expectations of fines also increase helmet use on long distance trips when average speed or confidence are included in the regressions. Regarding the impact of the previously omitted variables on helmet adoption, speed appears to be positively correlated with helmet use on long journeys. Individuals who frequently use a motorbike are significantly more likely to wear a helmet when traveling on main roads. Finally, drivers who believe they drive better than others are less likely to use a helmet for long trips or trips in residential neighborhoods. In this latter case, risk-aversion is found to be positively correlated with helmet use on main roads.

Finally, the understanding, by all respondents, of the probability scale used to derive subjective probabilities may be questioned. Before eliciting subjective expectations of probabilities and outcomes regarding injury and fines, interviewees were asked several questions in order to be able to verify whether they properly understood the probability scale (see Appendix B). I compare the results reported in Table 3 to the coefficients obtained if excluding individuals who did not correctly answer these control questions (Table not shown). Similar findings of the influence of subjective expectations on helmet adoption are found for the different samples considered (excluding individuals who answered incorrectly to one or more control questions). The magnitude of the effects are quite constant across samples: an increase of 100 INR in the unconditional expected fines, increases by around 7 percentage points (from 6.3 to 7.9) the probability of wearing a helmet on short distance trips on main roads and by 5 percentage points (from 4.8 to 5.2) the probability of using a helmet in residential neighborhoods.

Given the outcomes of these further tests, the results presented in the main analysis can be described as robust.

4.2 Influence of previous experiences on subjective expectations

In the following paragraphs, I study the impact of past road related events on beliefs. I start with the subjective expectations regarding injuries.

Table 8 reports the results found for the specifications with the police zone fixed effects (cf. equation 2). Interestingly, involvement in an accident decreases the variance related to medical costs. Following an accident, individuals actually seem to have a clearer idea of the health risks they face. While praying daily decreases one's subjective probability of being injured in a road accident when not using a helmet, expected medical expenditure and variation in these costs are higher among religious individuals who have personally experienced a road accident than among those who have not. As for individuals who use the motorbike to commute to work, they report significantly higher probabilities of being hurt.

When looking at results from the OLS specifications (not shown in Table 8), the frequent use of a motorbike seems to decrease the impact of a personal road accident on the subjective probability of being injured, indicating that the number of trips mitigates the adverse impact of road accident experiences. Furthermore, it appears that knowing someone who has been involved in an accident increases the subjective probability of being injured in a road accident if not using a helmet, while personal experience has no significant impact. Different reasons may explain this finding. First, personal involvement in a traffic accident may correspond to very different events. Second, sample selection may be at play as individuals who suffered from severe road injuries may no longer use a motorbike or may not even have survived the crash.[10] Third, remembering that a friend or a family member was involved in a traffic accident is more likely if this crash was quite severe. Differences in road quality and incidences of road accidents between neighborhoods may partly explain the level of expectations, as the influence of knowing a person who was involved in an accident vanishes once circle fixed effects are introduced. In 15 circles out of 32 none of the respondents knew a person who had been involved in a road traffic accident. This may either support the quality of roads argument or imply that fixed effects estimations cannot capture the effect of knowing someone who is involved in an accident because, in this regard, individuals are quite homogeneous.

[10] According to the information gathered, very few individuals (2% of the sample) were involved in a severe crash.

Table 8: Determinants of injury expectations

	subjective probability of injury if no helmet	subsequent outcomes	
		expected costs	inter-quartile range
	(1)	(2)	(3)
Experienced a road accident	0.042	-5.377**	-8.266**
	(0.052)	(2.146)	(3.607)
Has a relative involved in a road accident	0.030	2.275	3.226
	(0.040)	(1.500)	(2.149)
Uses the motorbike to commute to work	0.068***	0.071	0.758
	(0.019)	(0.583)	(0.851)
Uses the motorbike frequently	0.053**	-0.676	-1.254
	(0.023)	(1.064)	(1.769)
Experienced a road accident × Uses the motorbike frequently	-0.125	2.263	4.119
	(0.080)	(2.129)	(4.422)
Prays daily	-0.069***	-1.059	-1.420
	(0.023)	(0.759)	(1.208)
Experienced a road accident × Prays daily	0.065	5.668**	10.401**
	(0.072)	(2.210)	(4.183)
R^2 within	0.048	0.017	0.018
Observations	*828*	*765*	*765*
Hausman test (p-value)			
OLS vs. FE	0.000	0.000	0.000
FE vs. RE	0.000	0.037	0.023

Notes: Robust standard errors are reported in parentheses. *** 1%, ** 5% and * 10% significance.
All explanatory variables are binary variables.
Remark: The difference in the number of observations comes from the fact that individuals who gave a zero probability of injury did not answer to the medical expenditure questions. Moreover some respondents who gave a non-zero probability did not reply to the outcome questions.

Let us now focus on the effects of past police sanctions on subjective expectations regarding fines.

Table 9 presents the results from the random effect specifications.[11] Having previously been sanctioned by the traffic police increases both the expectation that a fine will have to be paid and the uncertainty with respect to the financial penalty. This latter effect may be explained by repeated sanctions of different amounts.

Arbitrariness in the traffic police sanctions, measured through the subjective probability of being stopped by the police for no reason, increases the subjective probability of being

[11] These should be preferred to the fixed effect specifications according to Hausman tests.

sanctioned if not using a helmet. Conversely, individuals who think they can bribe police officers report significantly lower probabilities of arrest. These two variables can be considered as proxies for previous interactions with traffic forces. Motorcyclists who use the motorbike to go to work report significantly higher probabilities of being caught by the police if not wearing a helmet.

Table 9: Determinants of fine expectations

	subjective probability of police arrest if no helmet	**subsequent outcomes**	
		expected costs	**inter-quartile range**
	(1)	(2)	(3)
Has been sanctioned by the police	0.045	0.548*	0.487*
	(0.034)	(0.298)	(0.271)
Discretionary power of police	0.201***	0.198	0.258
	(0.059)	(0.190)	(0.230)
Police officers can be bribed	-0.044*	-0.123	-0.149
	(0.025)	(0.097)	(0.100)
Uses the motorbike to commute to work	0.033*	0.044	0.036
	(0.019)	(0.084)	(0.081)
Uses the motorbike frequently	0.035	-0.059	0.017
	(0.027)	(0.093)	(0.078)
Prays daily	-0.042	-0.020	-0.132
	(0.029)	(0.074)	(0.099)
R^2 overall	0.025	0.026	0.034
Observations	*821*	*702*	*702*
Hausman test (p-value)			
OLS vs. FE	0.000	0.000	0.000
FE vs. RE	0.967	0.689	0.487

Notes: Robust standard errors are reported in parentheses. *** 1%, ** 5% and * 10% significance.
All explanatory variables except the 'Discretionary power of police' are binary variables.
The discretionary power of the police corresponds to the probability of being stopped by the police for no reason.
Remark: The difference in the number of observations comes from the fact that individuals who gave a zero probability of injury did not answer to the medical expenditure questions. Moreover some respondents who gave a non-zero probability did not reply to the outcome questions.

5 Policy implications

In order to be able to formulate policy recommendations, I now consider different road safety policies which are likely to influence individuals' expectations of injuries and fines when not wearing a helmet, and estimate their impact with respect to helmet use.

5.1 Raising the expectations of fines

I first study policies which impact the expectations related to fines by individuals infringing the helmet law, either through information on the official level of the fine, its perceived enforcement level or its level per se.

In order to simulate policies and estimate their impact on helmet adoption, I run probit specifications with circle dummies clustering standard errors at the police zone level. The results obtained, both in terms of significance and magnitude, are very similar to those obtained with the fixed effect linear probability model. Based on these probit estimations, Table 10 reports the estimated impact on helmet use if motorcyclists are fully aware of the current level of fine (Scenario 1), if the official fine is raised up to 500 INR (Scenario 2), if individuals are fully aware of the current level of fine and expect always to be caught by the police when not wearing a helmet (Scenario 3), and if perfect enforcement and information is associated with a higher official fine of 500 INR (Scenario 4). The chosen multiplication factor of fines ($\times 5$) coincides with an amendment of the Motor Vehicle Act currently under discussion in the Indian Parliament. As expected from the empirical analysis, larger gains regarding helmet adoption are obtained on short distance trips, in particular those on main roads. The limited increase in helmet use for longer trips can be explained both by a bigger role of expected injuries in this particular decision-making process and by the smaller room for improvement for this type of trip. A larger impact is found when substantially raising the official fine. More precisely, scenarios 2 and 4 lead to an increase of 25% to 40% respectively of helmet use on short distance trips.

When comparing number of past encounters with the police as stated by the respondents to the survey with administrative traffic police data, we note that the number of offenses for not using a helmet in 2011 per police zone is positively correlated to the share of respondents

Table 10: Estimated helmet use for changes in expectations of fines

Helmet use	on main roads for long trips	on main roads for short trips	for trips in the neighborhood
observations	*610*	*663*	*660*
Current UEC fines (INR)	90	93	93
Observed helmet use (%)	78.20	59.58	53.03
% change in helmet use			
Scenario 1 EC = 100 INR	+ 0.14%	- 3.12%	- 1.36%
Scenario 2 EC = 500 × info. coeff.	+ 2.33%	+ 23.36%	+ 25.12%
Scenario 3 UEC = 100 INR	+ 0.41%	+ 2.55%	+ 1.53%
Scenario 4 UEC = 500 INR	+ 2.85%	+ 49.56%	+ 32.43%
Δ in percentage points			
Scenario 1 EC = 100 INR	+ 0.11	-1.86	-0.72
Scenario 2 EC = 500 × info. coeff.	+ 1.82	+17.49	+13.32
Scenario 3 UEC = 100 INR	+0.32	+1.52	+0.81
Scenario 4 UEC = 500 INR	+2.23	+29.53	+17.20

Notes:

Scenario 1: perfect information, individuals expect to pay 100 INR, i.e. the official fine.

Scenario 2: raising the official fine up to 500 INR, but keeping enforcement and information level as it is.

Scenario 3: perfect information and enforcement with current level of fine.

Scenario 4: perfect information and enforcement with an official fine at 500 INR.

living in that area who declare they have been stopped by the police for infringing the helmet law. According to these figures, it seems important not only to publicize the financial penalties individuals may face when not using a helmet but also to increase the actual enforcement of helmet legislation. Similar findings are found by Lu et al. (2012). These authors implemented a randomized experiment in China and showed that telling drivers that they have been caught by electronic devices deters them from infringing the road rules in the future, whereas providing them with information on the likelihood of punishment does not. The acceptance and efficiency of such repressive rules depend also on the way they are implemented. Information prior to the change in traffic sanctions and a period of time during which road users are stopped by the police but not sanctioned are key to enabling individuals to accept the validity of the fine and its amount.

5.2 Raising the expectations of medical expenditure

I now focus on different scenarios of expectations of medical costs and relate them to policies such as awareness campaigns regarding the traffic mortality rate or the usefulness of a helmet.

I do not have access to any official data regarding the actual health expenditure road victims face. I therefore simply consider different scenarios with increasing unconditional expected medical costs and estimate the level of helmet use associated with each of these levels of expenditure for different motorbike trips. Table 11 reports the simulated change in percentage of use. While no increase in the share of motorcyclists wearing a helmet is found on short distance trips, doubling the expected injury costs (from 2,400 to 5,000 INR) raises the use of a head protection device for long distance trips by 0.5 percentage points. A share of 98.2% of motorcyclists using a helmet on long distance trips, implying an increase of 20 percentage points, is obtained when multiplying by 20 the individuals' expected medical expenditure. These results suggest that awareness campaigns stressing the high costs associated with road injuries in the event of an accident, and in particular if not using a helmet, might be useful in increasing helmet use among motorcyclists in Delhi. Lewis et al. (2007) summarized the literature on road safety media campaigns and concluded that the impact of shocking advertisements is somewhat mixed and inconsistent. Fear campaigns must therefore be used with caution. Using factual information or humor might be alternative options.

Finally, highlighting the risk one faces even on short distance trips could raise the use of helmets among individuals who use a motorbike only in the vicinity of their homes. When imputing the estimated impact of unconditional expected medical costs on long trips to helmet use on short distance trips (Scenario 8), it appears that if individuals thought that short distance journeys imply similar health risks as longer trips, an increase of around 6% in the share of individuals who use a helmet would be observed.

Table 11: Estimated helmet use related to changes in expectations of medical expenditure

Helmet use	on main roads for long trips	on main roads for short trips	for trips in the neighborhood
observations	*610*	*663*	*660*
Current UEC medical expenditure (INR)	2,408	2,704	2,755
Observed helmet use (%)	78.20	59.58	53.03
% change in helmet use			
Scenario 5 UEC = 5,000 INR	+3.04%	+0.82%	+1.21%
Scenario 6 UEC = 10,000 INR	+7.40%	+0.99%	+1.79%
Scenario 7 UEC = 50,000 INR	+25.63%	+2.40%	+6.56%
Scenario 8 $\hat{\beta}^{long}_{UECinj}$	-	+4.63%	+6.54%
Δ in percentage points			
Scenario 5 UEC = 5,000 INR	+2.38	+0.49	+0.64
Scenario 6 UEC = 10,000 INR	+5.79	+0.59	+0.95
Scenario 7 UEC = 50,000 INR	+20.04	+1.43	+3.48
Scenario 8 $\hat{\beta}^{long}_{UECinj}$	-	+2.76	+3.47

Notes:
Scenario 5: doubling the expectations of injury costs.
Scenario 8: imputing the estimated impact of unconditional expected medical costs for long journeys on helmet use to short distance trips.

6 Conclusion

This paper studies motorbike users' decision of whether to wear head protection or not, using original data collected in a metropolitan city in a low income country, namely, New Delhi. I study the impact of subjective expectations of injury and fines on helmet adoption; this in various traveling situations differing by the length of the trip and the types of roads taken. I find that expectations regarding medical expenditure increase the adoption of helmet on long distance trips on main roads. Conversely, the threat of police sanctions explains helmet use on short distance journeys. Differentiated effects are found along lines of gender and income. In a second step, I explore the factors which may explain the observed differences in expectations across motorcyclists. I show that road exposure and previous road related experiences are correlated with individuals' personal opinions.

Furthermore, an increased police threat through enforcement, information or fine levels should increase helmet use on short distance journeys. In fact, combining these measures should be even more effective. Information campaigns stressing the usefulness of a helmet to avoid severe injuries (implying important health expenditure), even for motorbike trips in the local vicinity, are also likely to make motorcyclists adopt safer behavior.

Many directions for future research can be undertaken to complete and improve the findings presented here. First, a follow-up survey could study the evolution of expectations regarding injury and fines and estimate the actual impact of road accidents and traffic fines by controlling for the timing of these events. Second, policy evaluations could be implemented in the future, either through an intervention, for instance an information campaign regarding the utility of helmet use, or through a quasi-experiment taking advantage of a change in the level of the fines for the non-use of helmets; a policy which is still being debated in the Indian Parliament.

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Appendices

Appendix A. Formulation of the subjective expectation questions

Probability of injury

in general - *"Think about the way you generally travel on the motorcycle. Given this, how likely do you think it is that you will have an accident in which you get injured?"*

if no helmet - *"If you are not wearing a helmet, how likely do you think it is that you will have an accident in which you get injured?"*

Probability of police arrest

in general - *"Think about the way you generally travel on the motorcycle, what is the likelihood that you will be stopped by the police in the next month?"*

if no helmet - *"If you do not use the helmet at all during the next month, what is the probability that the police will stop you at least once over that period?"*

for no reason - *"According to you, what is the likelihood that you will be stopped by the police for no reason in the next month?"*

Answer scale

Respondents answered using a 11 point scale from 0 "this event will never happen" up to 10 "this event will surely happen". I then divided their answers by 10 to obtain probabilities between 0 and 1.

Medical expenditure

"Thinking about the medical expenditure you would incur if you were injured in a road accident right now when not wearing a helmet, what do you think is the percent chance that this amount will be less than X INR ?"

A series of fixed amounts ranging from 500 INR up to 200,000 INR were proposed, with the enumerator proposing higher amounts till the respondent answered 100%.

Fines

"Thinking about the fine you would have to pay if you were stopped by the police right now for not wearing a helmet, what do you think is the percent chance that this amount will be less than X INR ?"

A series of fixed amounts ranging from 50 INR up to 1,000 INR were offered.

Variables built

1. The expected cost $E_i(C)$ was computed based on the answers given: $E_i(C) = \sum_{k=1}^{n}(p_{ik} - p_{ik-1}) \cdot \left(\frac{C_k + C_{k-1}}{2}\right)$, with p_{ik} the percent chance that the cost will be less than the amount Y_k for individual i, $\frac{C_k + C_{k-1}}{2}$ the central value of each interval and $p_{ik} - p_{ik-1}$ the percent chance associated to each interval. Initial values C_0 and p_{i0} are equal to zero.

2. The inter-quartile range, which corresponds to the difference between the 75$^{\text{th}}$ and 25$^{\text{th}}$ percentiles, has also been computed. Based on the answers provided, the 25$^{\text{th}}$ and the 75$^{\text{th}}$ percentiles were derived through linear extrapolation. When a respondent gave for the first proposed amount a higher percentage than 25 or 75, the lowest level of medical expenditure (500 INR) was imputed to the percentile.

Appendix B. Excluding individuals who did not understand the probability scale

Five general questions were asked to respondents in order to control for their understanding of the scale.

First, we checked their understanding of the probability concept:

1. *"Imagine I have 5 balls, one of which is red and four of which are blue. If you pick one of these balls without looking, how likely it is that you will pick the red ball?"* - variable named "red ball" below.

Two nested questions were also asked:

2. *"How likely are you to go to the market sometime in the next two days?"* - variable named "2 days" below.

3. *"How likely are you to go to the market sometime in the next two weeks?"* - variable named "2 weeks" below.

The variable called "nested" took the value 1 if the individual gave consistent answers to the above two questions.

Finally, we tried to check whether the entire scale was used by the respondent and therefore asked about events for which everybody should reply at the extreme values of the scale:

4. *"How likely do you think it is that you will go out of the house for any reason in the next month?"* - variable named "outside" below. This question turned out to be misleading, while we meant outside the house, some respondents understood out of the city. This confusion explain the unexpected results presented in Table 12.

5. *"How likely is it that Christmas will fall in the month of June?"* - variable named "Christmas" below.

Table 12: Check questions

	probability concept	**nested questions**		**extreme values**	
	red ball	2 days	2 weeks	outside	Christmas
event will not happen (%)	3.05	2.83	1.36	6.59	**96.06**
1	8.77	3.28	1.36	6.14	0.48
2	**24.24**	4.87	1.25	4.89	0.48
3	9.99	3.74	3.28	2.05	0
4	15.35	3.96	2.60	1.14	0.48
5	26.55	12.46	6.46	7.61	1.08
6	5.97	4.53	4.19	3.07	0
7	2.68	7.47	8.61	6.02	0
8	1.34	8.04	9.29	8.07	0.36
9	0.37	4.87	6.91	6.59	0.12
event will happen	1.71	43.94	54.7	**47.84**	0.96
Share of correct answers	24.24	84.60		47.84	96.06
observations	*821*	*883*	*883*	*880*	*837*

Notes: FIgures in bold indicate the share of individuals who provide the expected answer to each question.
Remark: 84.60% of respondents said that the probability that they will go to the market in the next two weeks was higher or equal as the probability they will go within two days.

Only 4 respondents gave no correct answer. 52% of the interviewees provided only one or no inconsistent answer. 36% gave two consistent replies out of four.